

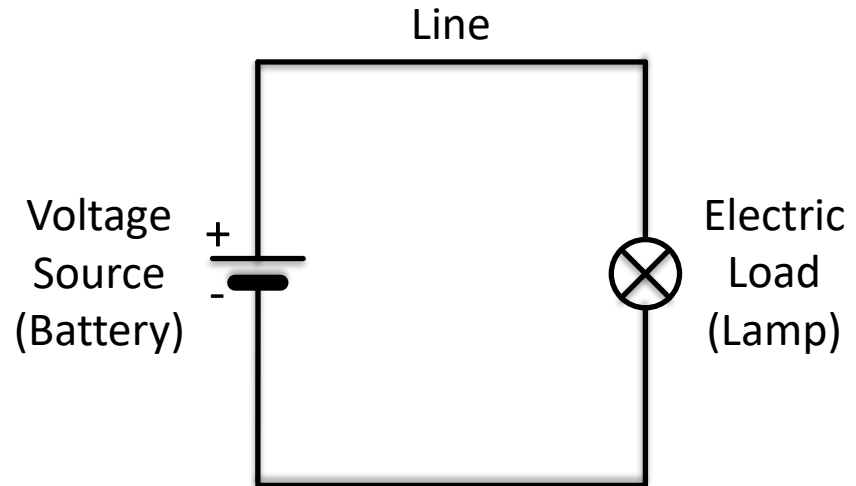
Electric Circuits

Electrical Engineering

Wolfgang Neff

Electric Circuit (1)

- Structure
 - Voltage source
 - Battery
 - Electric Load
 - Lamp
 - Electrical wiring
 - Line
 - Cable



Electric Circuit (2)

- Basics

- Voltage source

- A voltage is applied
 - Voltage V , [V] (Volt)

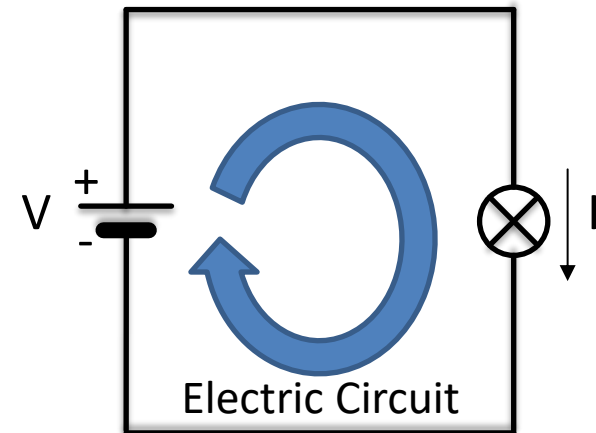
- Electric Load

Unit

- A current flows through
 - Electric current I , [A] (Ampere)

- Conventional direction of current

- The current flows from plus (+) to minus (-)



Electric Circuit (3)

- Electric Circuit

- Resistor

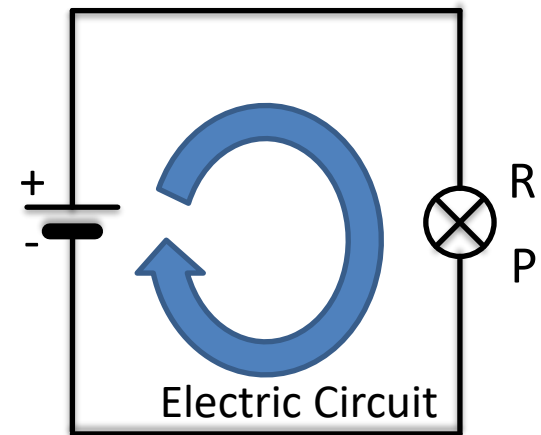
- A load hinders the current
 - Resistance R , [Ω] (Ohm)

- Power

- A load consumes power
 - Power P , [W] (Watt)

- Formulas

- $R = \frac{V}{I}$, $P = V \cdot I$



Electric Circuit (4)

- Exercise

- If a voltage of 5 V is applied to a lamp and a current of 20 mA flows through it

- What is the resistance of the lamp?

- $R = \frac{V}{I} = \frac{5\text{ V}}{20\text{ mA}} = \frac{5\text{ V}}{0.02\text{ A}} = 250\ \Omega$

- What power is consumed?

- $P = V \cdot I = 5\text{ V} \cdot 20\text{ mA} = 5\text{ V} \cdot 0.02\text{ A} = 0.1\text{ W}$

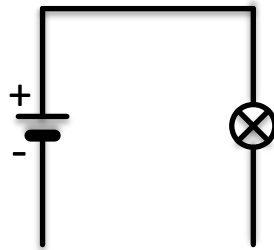
- $P = 0.1\text{ W} = 100\text{ mW}$

Electric Circuit (5)

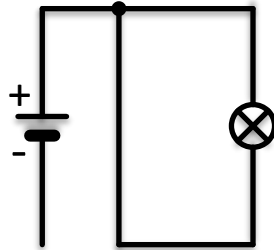
- Rules of Thumb
 - The current flows from plus (+) to minus (-)
 - Current is measured at a point
 - It flows through this point
 - It flows for example through a load
 - Voltage is measured between two points
 - It is applied at these points
 - Often one of these points is ground
 - Ground, GND \rightarrow 0 V

Electric Circuit (6)

- Rules of Thumb
 - Electric Current can flow only if ...
 - ... the electric circuit is closed

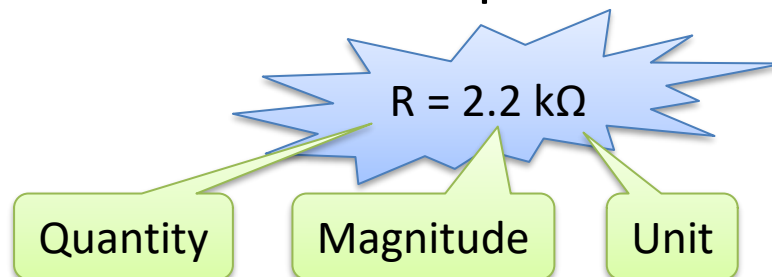


- ... there is a voltage difference



Unit Prefixes (1)

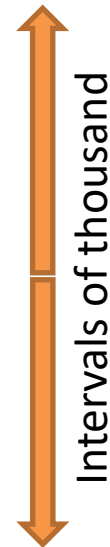
- Physical quantities
 - Have a magnitude
 - Should not have more than three digits
 - Should not have a decimal point
 - Exception: Circuit Diagrams (e. g. 2k2)
 - Have a unit
 - Prefixes are used to respect these rules



Unit Prefixes (2)

- Decimal unit prefixes (SI)
 - In technical applications powers of three are used
 - Centi and deci are usually not used

Text	Symbol	Value	Factor	Power
Giga	G	Billion	1 000 000 000	10^9
Mega	M	Million	1 000 000	10^6
Kilo	k	Thousand	1 000	10^3
-	-	One	1	10^0
Milli	m	Thousandth	0.001	10^{-3}
Micro	μ	Millionth	0.000 001	10^{-6}
Nano	n	Billionth	0.000 000 001	10^{-9}



Unit Prefixes (3)

- Binary unit prefixes (IEC)
 - One uses powers of 1024
 - $2^{10} = 1024 \rightarrow$ Quite close to 1000
 - There are texts and symbols of it's own
 - But they are seldom used

Text	Symbol	Factor	Power	Power
Gibi	Gi	1 073 741 824	1024^3	2^{30}
Mebi	Mi	1 048 576	1024^2	2^{20}
Kibi	Ki	1 024	1024^1	2^{10}
-	-	1	1024^0	2^0